

# NASA SBIR/STTR Success Story



University of Puerto Rico at Mayaguez

TDA Research Inc.

**TDA**  

---

**Research**

Prof. Arturo J. Hernandez-Maldonado, PhD

Ambalavanan Jayaraman, PhD

# About Us

---

- Research Institution: University of Puerto Rico at Mayaguez
- Small Business Partner: TDA Research Inc.
- Innovation: Highly Efficient Closed-Loop CO<sub>2</sub> Removal System for Deep-Space ECLSS
- Problem Addressed: Life Support System for Long Term Space Exploration

# Phase I STTR Work

---

- Deep space missions beyond the Low Earth Orbit require closed-loop livings systems to reduce the logistic burden
- TDA Research Inc.(TDA) in collaboration with University of Puerto Rico – Mayaguez (UPRM) is developing a highly efficient CO<sub>2</sub> sorbent wheel system for closed loop space craft cabin air re-vitalization during deep space missions
- Sorbent consists of a Sr-exchanged SAPO-34 zeolite developed by University of Puerto Rico – Mayaguez (UPRM) with previous research NASA University Research Centers (URC) funding
- The goal of the Phase I work is to
  1. Scale-up the sorbent production
  2. demonstrate high working capacity at low regeneration temperatures
  3. Demonstrate long life of the Sr-SAPO-34 sorbent
  4. Complete engineering design and analysis

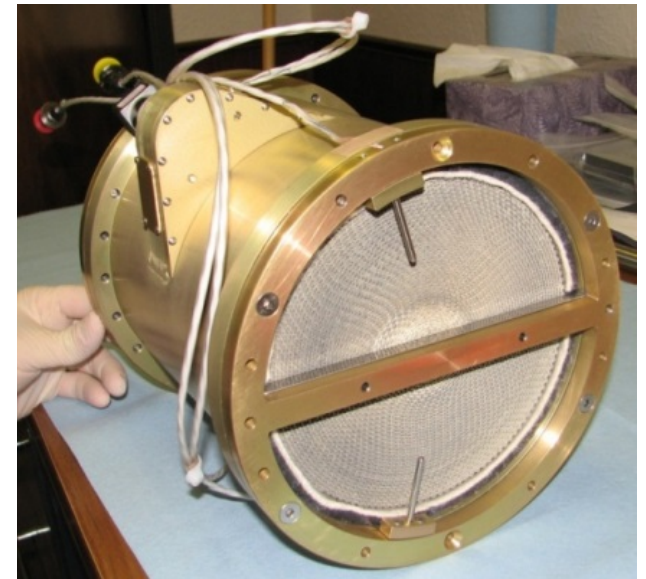
# TDA's System

---

- TDA has previously built a similar flight qualified sorbent wheel system for humidity removal and is being used in ISS with the amine swing bed (CAMRAS)
- TDA's CO<sub>2</sub> sorbent system can be used individually to remove both humidity and CO<sub>2</sub> or can be used to remove CO<sub>2</sub> only downstream of a separate humidity wheel

## **The advantages of TDA's Sorbent Wheel system are**

- Eliminates the valves and uses structured sorbent
- Eliminates sorbent attrition due to lower temperature regeneration and the use of structured sorbents



TDA's flight qualified desiccant wheel in ISS

# Phase I Accomplishments

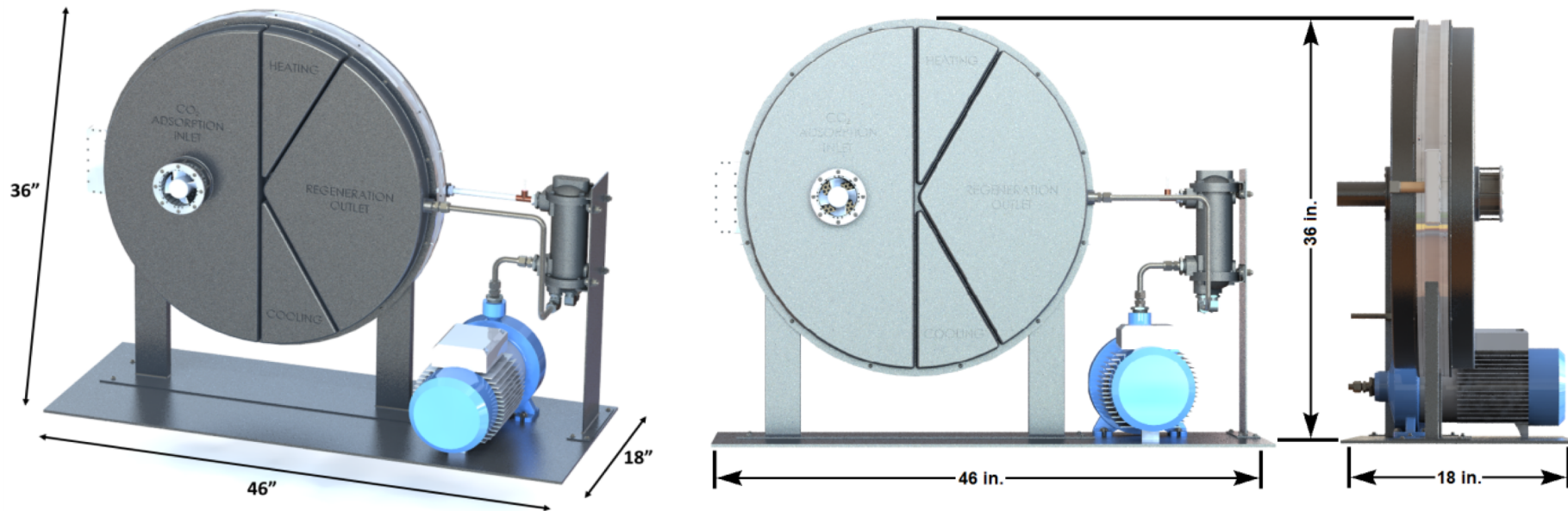
---

- We showed that preparing the Sr-SAPO-34 using microwave synthesis not only increased the working capacity of the sorbent, but also significantly reduced the synthesis time (by twenty fold); this will be critical when we scale-up the batch size
- We carried out a 170+ cycle fixed bed test, which showed that the sorbent was stable through multiple adsorption/ desorption cycles
- TDA's sorbent wheel based system can recover 4 kg/day of high purity CO<sub>2</sub>
  - Estimated overall system weight of 138 lbs (62.6 kg)
  - Estimated dimensions of 46" H x 36" L x 18" D
  - Compared to 382 lbs (173.3 kg) for the 4BMS system

# Phase I Results: System Design

## System Design and Engineering Analysis (TDA)

- TDA's sorbent wheel based system can recover 4 kg/day of high purity CO<sub>2</sub> at an estimated overall system weight of 138 lbs (62.6 kg) and dimensions of 46" H x 36" L x 18" D, compared to 382 lbs (173.3 kg) for the 4BMS system.



# Contact Information

---

## **Arturo J. Hernandez-Maldonado, PhD**

Professor of Chemical Engineering

University of Puerto Rico – Mayaguez

Department of Chemical Engineering

PO Box 9000

Mayaguez, PR 00681-9000

Office: IQ105N

E-Mail: [arturoj.hernandez@upr.edu](mailto:arturoj.hernandez@upr.edu)

Phone: 787-832-4040 x3748

Web: <http://academic.uprm.edu/arturojh/>